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Sustainable Economic Growth: A Critical Assessment of SDG 8.1[†]

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Abstract

In this report, we focus on the Sustainable Development Goal (SDG) target 8.1, stipulating that countries should pursue real GDP per capita growth rates that are in accordance with their national circumstances and that total GDP should grow by more than seven percent a year in the least developed countries. We start by briefly discussing the background of this target and then review some of the existing research on economic growth across the world, starting with growth theory and its predictions concerning the convergence of growth rates and income levels in the short and long term. We also review the extensive empirical work on cross-country income and growth regressions that have accumulated during the last three decades, focusing on recent (pre-covid) and historical patterns regarding the fulfillment of the SDG 8.1 targets. We show that a growth rate in total GDP of seven percent per year has only been observed in about 10 percent of all available country-year observations over history. Growth rates exceeding seven percent were relatively frequent among poor countries during 2000-2009 but not during 2009-2019. Since 2000, the relatively high average growth rates among poor countries have implied that their income levels have steadily converged towards those of richer countries, although at a slow pace. This pattern is manifested in longer periods of sustained growth episodes in poor countries and can probably be explained by successful policy reforms. We also show that about a third of all countries managed to have positive economic growth during 2010-19 while at the same time decreasing their emissions of CO_2 from production (decoupling). For poor and rich countries alike, the growth prospects post-covid and after Russia's invasion of Ukraine, are uncertain.

Keywords: economic growth, sustainable development goals, convergence, SDG 8.1

JEL code: N10, O47, O57

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1. Introduction

The gross domestic product (*GDP*) measures the total value of the production of final goods and services within a country during a given year, and the level of GDP and its relative change over time (*GDP growth*) are standard indicators of economic development.

SDG 8.1 defines two targets: (i) a sustained growth in GDP per capita in taking national circumstances into account, and (ii) a growth rate of total GDP of at least 7 percent in the least developed countries. One motivation for including these among the SDGs is that inequalities between countries in income per capita remain very high. In 2019, real GDP per capita in the richest (normal-sized) country, Switzerland, was 380 times higher than that in the poorest country, Burundi (World Bank, 2021). Furthermore, differences in growth rates of GDP per capita, i.e., the annual percentage change in GDP levels divided by the size of the population, are also substantial. In 2019, the average growth rate in the world was 1.3 percent but the span between the country with the highest growth rate (Timor-Leste at 16.4 percent) and that with the lowest (Zimbabwe, -9.4 percent) was almost 25 percentage units.

The level of GDP per capita is a very common measure of the relative economic prosperity and GDP growth is a key indicator of economic development. However, there are several important aspects of economic welfare that are not well covered by the measurement of GDP (Stiglitz et al., 2009). For instance, GDP per capita-levels do not provide information on how incomes are distributed in the population, and neither do they adequately reflect the quality of public services such as schooling and judicial system that are hard to value in monetary terms. Informal sector economic activity is usually not covered, the GDP data tells us nothing about the structure or sustainability of production, and the statistic does not capture the welfare trade-off between work and leisure. Nonetheless, a large number of studies display a strong positive correlation between GDP per capita and other potential measures of human welfare.[2]

In this context it is worth noting that economic growth has a positive association with several of the SDGs. The reduction of world *poverty* (SDG 1) and *hunger* (SDG 2) are greatly facilitated by a development where agricultural production and manufacturing wages increase. Countries with a high GDP per capita have a better potential for providing *good health* (SDG 3), *good education* (SDG 4), and *innovations and infrastructure* (SDG 9) to its population. Rich countries typically also have the capacity to maintain *peace* and *strong institutions*, like democracy and the rule of law (SDG 16), although the direction of causality is surely bi-directional.

[2] See for instance Jones and Klenow (2016) for a quantitative assessment of how cross-country welfare comparisons are adjusted when GDP data are combined with other measures of welfare.

However, sometimes, and especially among non-economists, it is argued that economic growth has a conflicting relationship with some of the other SDGs. For instance, SDG 13: *Climate Action* often stand in conflict with economic growth since increases in total GDP are often, but not always, associated with greater emissions of CO_2. Similarly, if the economic growth process is driven by the destruction of natural assets, such as rain forests, and consumption of non-recyclable materials, it stands in conflict with SDG 12: *Responsible production and consumption*. Although it is undoubtedly the case that economic growth in developing countries often is accompanied by greater emissions of CO_2 and a higher material footprint, that does not necessitate a causal relationship between economic growth and climate change or environmental deterioration. For instance, when GDP per capita increased by more than 50 percent in Sweden 1995-2019, production-based CO_2-emissions per capita fell by almost 40 percent, and consumption-based CO_2-emissions, which adjust domestic CO_2-emissions by adding emissions due to goods imported and subtracts emissions caused by goods exported, fell by 30 percent (Our World in Data, 2022) . Such a pattern is referred to in the literature as *decoupling*.

In this article, we review the literature on economic growth in relation to SDG 8.1 and provide an empirical analysis of to what extent the targets for economic growth in SDG 8.1 have been reached historically. A number of recent works have pointed to the fact that an absolute convergence of income levels has taken place during the last two decades, manifested by the faster growth rates of poor countries compared to rich countries. We show that over the period when economic growth data exists, GDP growth per capita has on average been 1.3 percent and growth rates of more than 7 percent have only been observed in about 10 percent of all available country-years. Moreover, a global pattern of absolute convergence of growth rates can be demonstrated during the last two decades, yet while short-lived economic booms are relatively common, and sustained periods of positive economic growth have become more common lately among the poorest countries, very few countries have consistently reached growth rates of 7 percent. As for whether growth has been (ecologically speaking) sustainable, we show that about one third of all countries have managed to achieve an absolute decoupling of economic growth and CO_2-emissions during the last decade (pre-covid). Recent macroeconomic shocks such as the COVID-19 pandemic and the Russia-Ukraine war have rendered predictions about the future attainability of SDG 8.1 very uncertain.

The paper is structured as follows: In section 2, we review the literature on economic growth, starting with the theoretical fundaments, and then moving on to existing empirical research. In section 3, we analyze existing data on economic growth as discussed above. Section 4 includes a discussion about whether research can influence policy and the post-covid situation in the world. Section 5 concludes the paper.

2. Research on economic growth

In this section, we start, in Section 2.1, by briefly presenting the main outlines of the Solow growth model, which provides the theoretical foundation for most of the cross-country empirical work on convergence of income levels. Readers who are only interested in the empirical findings can skip Section 2.1. Sections 2.2-2.5 then present a review of the main empirical evidence in the existing literature.

2.1 Growth theory

The key model for understanding economic convergence in GDP levels was presented by Robert Solow (1956).[3] The central assumptions of the so-called *Solow model* are the following. (i) Total production in a country during a year Y can be described by a multiplicative aggregate production function $Y = f(K(t), A(t)L(t)) = K_t^{\alpha}(A_t L_t)^{1-\alpha}$, featuring the variables physical capital (K), labor (or the size of the total population) (L), and labor-augmenting technology (A) where all variables, in turn, are functions of time t. (ii) Both K and AL have diminishing marginal products ($0<\alpha<1$) and the production function is characterized by constant returns to scale (exponents sum to 1). (iii) Total production can be used for either private consumption (C) or investment (I). There is no government or no trade in goods, services or financial assets. (iv) The savings rate s is exogenously given, as are the capital depreciation rate $\delta>0$ and the population growth rate $n>0$. For simplicity, we here set the growth rate of technological knowledge A to zero. (v) The accumulation of physical capital is an endogenous component of the model and is given by the central "k-dot"-equation:

$$\dot{k}(t) = sf\big(k(t)\big) - (\delta + n)k(t) \qquad (1)$$

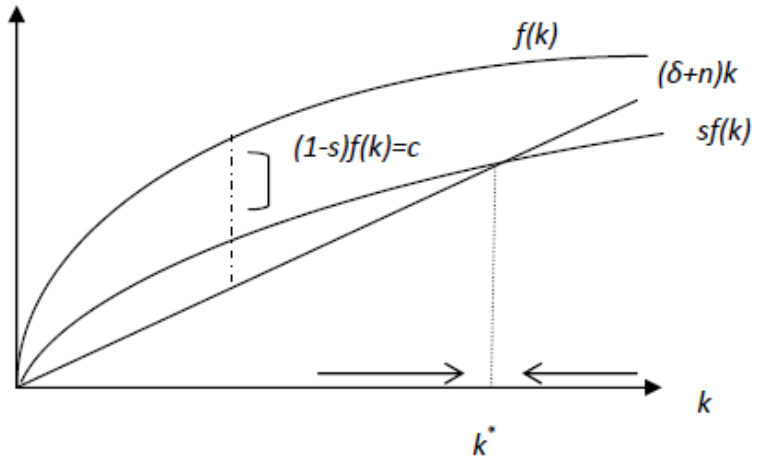
In this expression, we have written the capital accumulation function in intensive form so that $k=K/(AL)$ is expressed as *capital per unit of effective labor* and where $\dot{k}(t)$ is the time derivative of the effective capital stock, i.e., the speed of change in k. Whether this expression is positive, zero, or negative depends on the size relationship between the level of investment on the left-hand side, $sf(k)$, and the factors on the right-hand side, $(\delta+n)k$, that act as a "drag" on the accumulation of the effective capital stock.

The graphical counterpart of equation (1) is shown in Figure 1. When $sf(k)>(\delta+n)k$, we have that $\dot{k} > 0$ and the effective capital stock k increases and moves horizontally to the right in the figure. When $sf(k)<(\delta+n)k$, the effective capital stock shrinks towards the left. When $sf(k)=(\delta+n)k$, the effective capital stock has reached its *steady-state equilibrium level,* k^*, where it no longer changes. The vertical distance between the $f(k)$- and the $sf(k)$-curves at a given k in the figure, is equivalent to the level of

[3] For more elaborate presentations of the Solow growth model and its many implications, see for instance Acemgolu (2009) or Olsson (2012).

consumption per effective worker, $c=(1-s)f(k)$, which is the factor that households gain utility from (as can be shown in the richer *Ramsey growth model* (Acemoglu, 2009)).

Figure 1: The Solow growth model



Note: The figure shows the standard diagram for the Solow growth model from Solow (1956). Source: Olsson (2012)

In line with equation (1), and assuming for simplicity that L is equivalent to the total population, we can express output per capita as $Y/L=y=Af(k)$. Clearly, countries with a high level of technological knowledge A will have a high GDP per capita, but in the example here, this level is assumed to be constant. It can be shown that the growth rate of output per capita will be a linear function of the growth rate of the effective capital stock so that

$$\frac{\dot{y}}{y} = \alpha \frac{\dot{k}}{k} = \alpha\left(\frac{sf(k(t))}{k} - (\delta + n)\right) = \alpha\left(\frac{s}{k^{1-\alpha}} - \delta - n\right). \quad (2)$$

A number of things to note with this equation: First, the expression in equation (2) is the equivalent of a percentage growth rate in output per capita. Second, for a given level of k, the economic growth rate in the Solow growth model increases with the saving rate s and decreases with both the capital depreciation rate δ and the population growth rate n.[4] Third, and this is the key take-away in the present context, equation (2) shows that with all other parameters held constant, the growth rate of output per capita will be negatively associated with the initial level of $k=K/(AL)$. Poor countries are found to the left in Figure 1 as their k is low since the stock of total physical capital K is low while population levels tend to be high. At low levels of k, the marginal product of capital is relatively high, which means that $\dot{k}$

[4] The effect of the saving rate follows from the closed economy assumption of no trade. In an open economy, investments can be financed either by domestic savings or by borrowing from abroad, implying a negative current account balance.

is high, as well as economic growth. When $k=k^*$ as in the rich OECD countries, $\dot{k} = 0$ and economic growth is zero.[5] Thus, a fundamental prediction of the Solow growth model is that poor countries with a low initial level of k (and hence a low GDP per capita) should grow *faster* than richer countries and eventually catch up with their level of effective capital and output. This is what is referred to as *convergence of output levels*. The prediction of convergence from the Solow growth model has been tested in numerous empirical cross-country analyses over the years and is the cornerstone of empirical work in the field.

Lastly, as a reminder of what economic growth entails, it is useful to restate the fundamental GDP identity:

$$Y = C + I + G + X - M = Profits + Wages + Other\ income \qquad (3)$$

This equation, which is the basis of the national accounts of countries, states that the total value of all goods and services produced in an economy during a given year Y must be equal to the sum of aggregate consumption C, total investment I, government expenditure G, exports X minus imports M. GDP growth is thus equivalent to an increase in expenditures in the country. The *expenditure side* of the GDP identity must in turn be equal to the different aggregated types of income in the national economy, including *profits*, *wages*, and other income sources such as rent, interest, etc., implying that a growth of GDP reflects a growth of the total income generated in the country. Government expenditure is further usually assumed to be balanced in the long run with total tax revenue so that $\tau Y=G$ where $\tau<1$ is the tax quotient as a share of GDP. Hence, by promoting economic growth so that Y increases, total tax revenues, and government expenditures, increase even at a constant tax quotient τ.

2.2 Cross-country regressions

Starting with Barro (1991), different empirical specifications on the basis of equation (2) have been estimated over the years. The standard growth regression equation is:

$$\Delta_z y_{it} = \beta_0 + \beta_1 y_{it} + \beta_2 X_{it} + \eta_t + \gamma_i + \varepsilon_{it} \qquad (4)$$

where $\Delta_z y_{it}$ is the growth rate of GDP per capita from year t to $t+z$ in country i and y_{it} is the logged initial level of output per capita, and X_t is a vector of additional time-varying, country-specific controls that includes variables such as the population growth rate n and the investment rate (a proxy for s in equation (2)) that follow from the Solow equation in (2), as well as other variables that are the main independent variable of interest in a particular study (such as the level of democracy, conflict levels, natural resource abundance, etc). Furthermore, η_t is a time or period dummy when the sample is a panel

[5] In a slightly extended version of the model, we might have assumed that the rate of technological progress was $g>0$, in which case we would get the reasonable prediction that the steady-state growth rate of countries at k^* was not 0 but equal to $g>0$ (see for instance Olsson, 2012).

of countries, γ_i is a country-fixed effect and ε_{it} is an error term. Time fixed effects are included to capture the effect of worldwide temporary shocks or trends, whereas country-fixed effects are intended to pick up persistent country-specific characteristics (such as a country's geography, location, or pre-sample historical events) that might influence economic growth. The issue of whether studies should include country fixed effects alongside various country and time-specific controls in X_{it}, has recently been discussed in the literature (Acemoglu and Molina, 2021) and we will briefly come back to it later. The time frame z can vary and is typically 1 to 10 years.

In cross-country convergence studies, the key coefficient is β_1, showing whether the sample features convergence or not. When all the standard control variables in X_{it} are included, a significant coefficient $\beta_1 < 0$ implies that we have *conditional convergence*, i.e., when controlling for other sources of country heterogeneity, countries with a low level of GDP per capita in initial year t have a significantly higher average growth rate between t and $t+n$, in line with the prediction from the Solow model in equation (2). When no other variables than initial GDP per capita (and a constant) is included and we still have a negative and significant β_1, we refer to this as *absolute convergence* (also referred to as *unconditional convergence* or *β-convergence*).

Early studies such as Barro (1991) found evidence of conditional but not absolute convergence. In an updated paper from 2015, Barro uses a panel of countries with data from 1960 with z=5 and where each country is observed 10 times over 1960-2010. When including country and time fixed effects, he finds robust evidence of conditional convergence and that over the long run, countries tend to converge by about 2 percent a year (Barro, 2015). The failure to observe evidence of absolute convergence in the early studies partly motived an influential empirical literature on long-run comparative development with fundamental (and persistent) institutions such as property rights, constraints against governments, and the rule-of-law, as the main source of variation, and with income levels as the dependent variable in cross-sectional settings (Acemoglu et al, 2005; Olsson and Hibbs, 2005).[6]

2.3 Recent research on SDG 8.1 and convergence

In our literature search, we could not find any paper that explicitly quantitively evaluated progress on SDG 8.1 so far, probably because we are still early in the 2015-30 period. In fact, very few articles in economics addressed the issue at all.

In other social sciences, it is a recurring theme to question economic growth as a suitable sustainable development goal, a critique that is almost never addressed or responded to by economists. For instance,

[6] See for instance Galor (2021) for an accessible introduction to this large literature which will not be covered here.

Hickel (2019) argues that the target of increased economic growth in SDG 8.1 appears to be incompatible with reductions in CO_2-emissions and resource use and discuss the notion of *degrowth*, i.e., a descaling of production and consumption that would increase human well-being while at the same time also investing in social services and improving wages. A similar argument is made by Naidoo and Fischer (2020, p. 200) in *Nature* where they simply state that "If the world's economic pie cannot increase, it must be sliced in different ways." One important way of re-dividing the pie is, according to them, to "rein in corporate profits." In short, many of the papers in this tradition argue that economic growth does not substantially contribute to the attainment of the SDGs, that it should not be a target in itself, and that a redistribution of resources is a more promising path towards fulfilling the SDGs. Our conclusion from this usually non-quantitative literature is that it is riddled with so many conceptual, methodological, and interpretative problems that it is not feasible to try to address them in a brief overview like this.

Several papers repeat the often-recurring critique that GDP is not a good measure of social welfare. The most well-known contribution on this theme recently is probably Stiglitz et al. (2009). In their comprehensive report, the authors first point to the many areas in which the measurement of GDP should be improved. One such area concerns the growing importance of complex services such as medical services, educational services, and communication technologies. Many services are characterized by quality improvements that are not easily measured. Government services such as roads, parks, and defense are often provided as collective goods which are hard to give a monetary value. The share of private and government services has increased a lot in many countries. Non-market economic activities, often carried out by women in the household, should be recognized to a greater extent. However, the authors also call for a shift in emphasis from measuring economic production to measuring people's well-being. Although the authors still think GDP gives valuable information about production, they hold that it should be complemented with other measures that rather focus on income and consumption. Household incomes, net of taxes and benefits, should be a particularly important statistic, as well as household levels of wealth and the cross-sectional distribution of income, consumption, and wealth. Apart from economic variables, human well-being is also strongly affected by health, levels of education, political voice and governance, social connections, and the quality of the environment (Stiglitz et al., 2009)

Cook and Davidsdottir (2019) argue, similarly, that growth might not bring benefits to the majority if the process is characterized by phenomena such as *jobless growth*, a growth with no or fewer new jobs added, growth that leads to *increasing inequality* (Piketty, 2014), or growth that undermines finite natural resources. The authors recognize that GDP per capita might still be an informative indicator of well-being but propose the use of alternative measures of macroeconomic well-being, such as an *environmentally adjusted net domestic product* (EDP) and *genuine savings* (standard savings/capital investments minus resource depletion plus human capital investments).

In her presentation of the framework of *doughnut economics*, Raworth (2017) is also critical of the use of economic growth as a measure of well-being. Her point of departure is a recognition that human livelihoods are ultimately constrained by biophysical *planetary boundaries* (building on Steffen et al., 2015) or *ecological ceilings* related to climate change, ocean acidification, land conversion, biodiversity loss, air pollution, etc. Human livelihoods, in turn, depend on social foundations that appear to provide the equivalent of well-being and are related to SDGs for health, education and income and work, etc. According to the doughnut scheme, there is a narrow band where needs are met without overshooting ecological ceilings. In many cases, however, these levels have now been surpassed and threaten planetary boundaries and ultimately human livelihoods. Raworth (2017) claims that a more equal and fairer distribution is possible by various policies that basically have in common that they would entail a massive reorientation from private property ownership of banks, companies, robots and ideas towards various collectively owned solutions, higher taxes on the rich, etc. Despite being an economist, Raworth (2017) does not consider the distributional struggles that would accompany such a collectivization.

In standard growth models within economics, households are not assumed to get well-being (referred to as *utility*) from economic growth per se but from a stable flow of lifetime consumption. Within economics, not only Stiglitz et al. (2009) but also leading macroeconomists Jones and Klenow (2016) recognize the limitations of GDP as a measure of well-being and therefore develop an alternative composite measure based on consumption, leisure, inequality and mortality within the standard framework of expected utility. Using cross-country data, they find that for the poorer countries of the world their measure of well-being welfare is often even lower than their GDP levels would suggest, due to them having a lower life expectancy and higher inequality. However, they also find that GDP per capita is an informative indicator of well-being across a broad range of countries since the two measures have a correlation of 0.9.

In recent years, a few papers in economics have returned to the issue of convergence. Kremer et al. (2022) and Patel et al. (2021) both confirm previous studies, such as Barro (1991), that find that conditional convergence prevailed at least until 1990. However, since 2000, there appears to have been both conditional and *absolute* convergence, driven by higher growth among poor countries and slower growth at the frontier. Kremer et al. (2022) further show how several of the correlates of growth and income, i.e., the *Solow fundamentals* (human capital, institutions, and culture) which are usually included in X_{it} in equation (4), also have converged substantially over the period. Easterly (2019) observes a similar trend but focuses mainly on the government policies typically emphasized in the policy packages of the "Washington consensus". These are captured by indicators such as the inflation rate, the black market premium, the real interest rate, currency overvaluation, or an extreme trade-to-GDP ratio. Easterly shows that the share of countries afflicted with such bad "policies" has consistently fallen at least since around 1990. This is likely to contribute to the observed pattern of absolute convergence. Patel et al. (2021) reach the conclusion that the very long period of divergence, since the

origin of colonialism to around 1990, has finally come to an end. Acemoglu and Molina (2021) argue that the finding of absolute convergence could be to regression misspecification, primarily the omission of country fixed effects, that it would be premature to assume a less central role for long-run determinants such as institutions, and demonstrate, based on Acemoglu et al. (2019), that a key institutional variable such as democracy still has a strong impact on growth.

3. Empirical analysis of target achievement

In this section, we evaluate SDG 8.1 along several dimensions. First, we present and discuss the formulation of the goal and illustrate with a few examples what it implies. Second, we provide a very brief description of the long-run growth history of the United Kingdom and of the world as a whole. Third, we discuss the attained annual growth rates in total GDP and in GDP/capita among all countries since the 1960s. Fourth, we present results regarding absolute convergence from a set of minimalistic growth regressions. Fifth, we discuss to what extent countries have been able to *sustain* growth. Lastly, we briefly touch on the question of *sustainable growth* and consider whether it has been possible to *decouple* economic growth from increasing CO_2-emissions.

3.1 The SDG 8.1 target

The SDG 8.1 target is formulated as follows:

"Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries."

The target relates to the growth rate of both GDP per capita, the canonical measure of living standards across countries, and total GDP. As we shall see, the distinction between these two is important since in developing countries, a high growth in total GDP is often accompanied by a high population growth rate, which might thus hold back increases in GDP per capita. It is not clear from the official documents why a target of 7 percent was set for SDG 8.1, yet it can be noted that to set a target for a growth rate at this level is equivalent to having a target of a doubling of GDP every ten years. An average growth rate of close to 7 percent has actually been the case in China since around 1980, yet the exceptional nature of this growth track record is why the Chinese experience is sometimes seen as a *growth miracle*.

As we shall see below, given the huge persisting inequalities in levels of real GDP per capita, growth rates in the vicinity of 7 percent annually will be required for something close to a meaningful convergence to take place. To illustrate this, some calculations are useful. Many refugees from poorer countries aspire to migrate to the European Union (EU), despite numerous serious obstacles along the way. EU includes both richer countries, such as Sweden and Netherlands, and relatively poorer ones,

such as Bulgaria and Romania. The average level of GDP per capita in EU in 2019 was 36,598 USD (in 2010 prices), which amounts to 66.5 percent of the US level of GDP per capita. The average level in countries the World Bank categorizes as "Low Income" was 799 USD, i.e., 2.2 percent of the EU level and only 1.5 percent of the US level. An equivalent way of expressing the income gap is to say that the average EU country was 46 times richer than the poorest countries.

How long would it take the poorest countries to converge to the EU level if their growth rate of real GDP per capita was 7 percent every year? Assuming a GDP growth rate of 1 percent per year for EU, which is, historically speaking, a modest figure, it would take 66 years for the gap to be closed. This is about two and a half generations. During any single year it might not seem important whether the growth rate of GDP is 7 percent or, say, 5 percent. Compounded over time, such a seemingly small difference in annual growth rates will have a sizeable effect on the long-run level of GDP per capita. If, all else equal, the Low Income-countries instead had a growth rate of 5 percent it would take them almost 100 years, or more than one an additional generation, to converge to the income level that the EU-countries (then will) have.

Consider the role of population growth for the difference between growth of total GDP and growth of GDP per capita. Approximately, GDP per capita growth is equal to total GDP growth minus population growth. Suppose a country could achieve a growth rate of total GDP of 7 percent per year. If the size of the population was constant, i.e., zero population growth, it would take this country 34 years to have both its GDP and its GDP/capita multiplied by a factor of 10, equivalent to going from 799 USD (the 2019 average for Low Income-countries) to 7990 USD. The average population growth among Low Income countries during the 2010-2019 period was 2.4 percent. A growth rate of total GDP of 7 percent and a population growth rate of 2.4 percent means that it would now take 51 years for GDP per capita to be multiplied by 10. That is, the number of years to reach the same average level of potential material well-being (GDP per capita) is now 50 percent higher.[7]

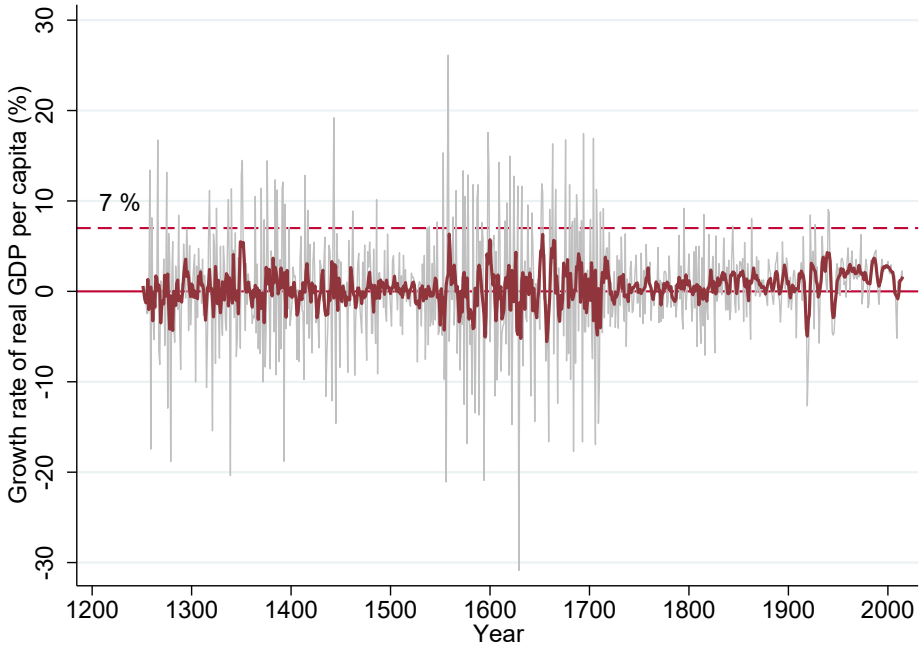
3.2 Economic growth in the UK and in the world since 1248

Figure 2 below on United Kingdom during 1248-2015, is based on data from the Maddison Project (Bolt et al., 2018) and shows annual growth rates in real GDP per capita and the 5-year moving average. The data comes from an unusually long time series and caution is warranted when interpreting growth figures that represent GDP observations several hundred years ago. Taken at face value, it was not uncommon with very high (or low) growth rates in per capita GDP in the preindustrial era. In total, annual growth

[7] At the current, i.e. 2010-2019 average, of growth rates in GDP and GDP per capita in Low Income countries, which are 3.98 and 1.34, respectively, it would take 59 years for GDP and 173 years for GDP per capita to be multiplied by a factor of 10.

rates exceeded 7 percent during 10.3 percent of all years and were particularly common in the period 1550-1710. However, the volatility in growth rates was also substantial in this period and very large declines in GDP were almost as common as sudden increases. From the mid-1700s, the swings are more moderate and average growth as a rule exceeds 0 percent during the 20th century. However, a sustained average growth rate of 7 percent over a five-year interval has not been achieved during United Kingdom's economic history.

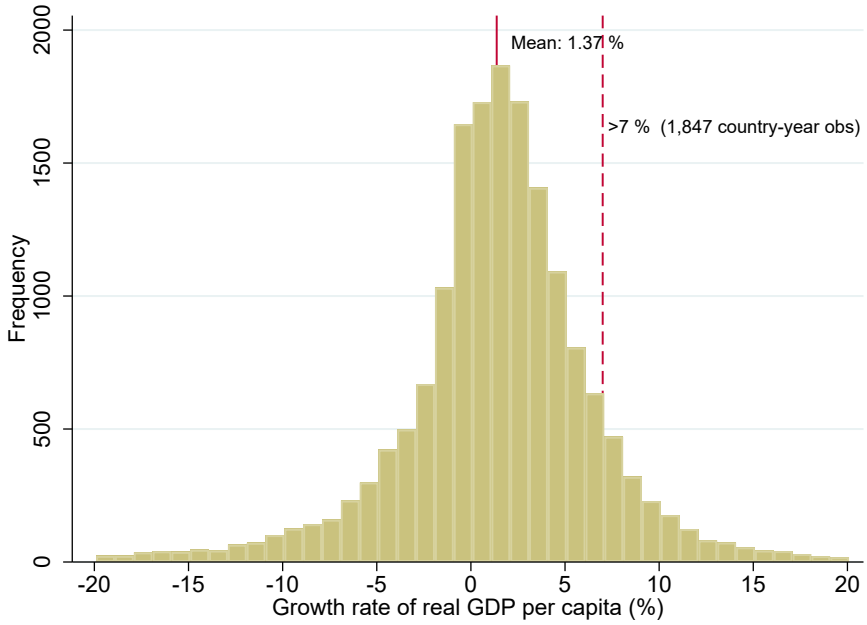
Figure 2: Annual and (5-year) moving average growth in the UK in GDP per capita 1248-2015



Note: The figure shows the annual growth rates in real GDP per capita (thin grey line), as well as a 5-year moving average (thick red line) during 1248-2015 for United Kingdom. Data is obtained from Bolt et al (2018).

In Figure 3, we show the distribution of all available country-year observations of real GDP per capita growth rates from 1248 to 2015 in an unbalanced sample of up to around 150 countries in the world (excluding outlier observations exceeding an absolute level of 20 percent annual growth rates). The sample is strongly biased towards contemporary observations, in particular from about 1960. The histogram displays a typical normal distribution with a mean level at 1.37 percent. There are in total 1,847 country-year observations with an annual growth rate in real GDP per capita exceeding 7 percent (10.9 percent of all 16,906 observations). This proportion is quite similar to the long-run figure of 10.3 percent for the United Kingdom discussed above.

Figure 3: Histogram of all available 16,906 country-year real growth rate observations 1248-2015 from Bolt et al (2018)



Note: The figure shows a histogram of 16,906 available country-year annual real growth rate observations during 1248-2015 in an unbalanced panel of more than 150 countries from Bolt et al (2018). Mean level (1.37 percent) and observations exceeding a 7 percent growth rate are indicated with vertical lines in the graph.

3.3 Economic growth since the 1960s

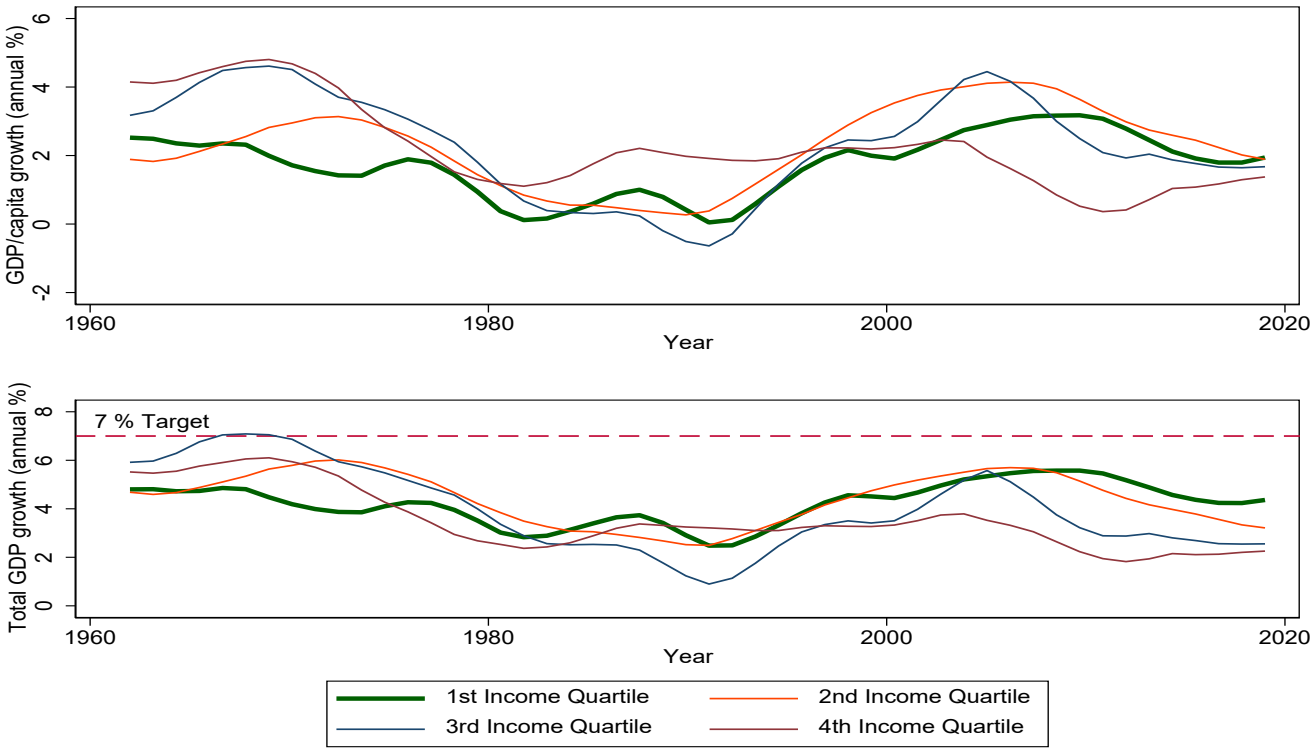
In this section, we analyze trends in annual growth rates among all countries since the 1960s. The data used is from the World Bank (2021), which is typically used for more contemporary analyses. Throughout when this data is used, we always exclude small countries with a population of less than half a million people.

In Figure 4 we present growth in per capita GDP (upper part) and growth in total GDP (lower part). Countries are bundled into income quartiles depending on their level of GDP per capita during the previous year and the figures represent the geometric average of the annual growth within each quartile during each year. Naturally, the composition of these quartiles changes over time as more countries become independent but also because the effects of growth differentials accumulate over time so that some countries move from one quartile to another.

The 1st income quartile, which represents the poorest quarter of the countries in the world (thick green line), tended to have per capita growth rates lower than those in the upper three quartiles until the early 1980s. Growth rates first trended downwards but then picked up again in all quartiles in the 1990s, but after the early 2000s growth in the top quartile fell back again. During the 2010s, total growth rates are higher in the bottom quartile than in the other quartiles, but the relatively higher population growth in

these countries mean that their *per capita* growth rates are comparable to the ones for the second and third quartiles.

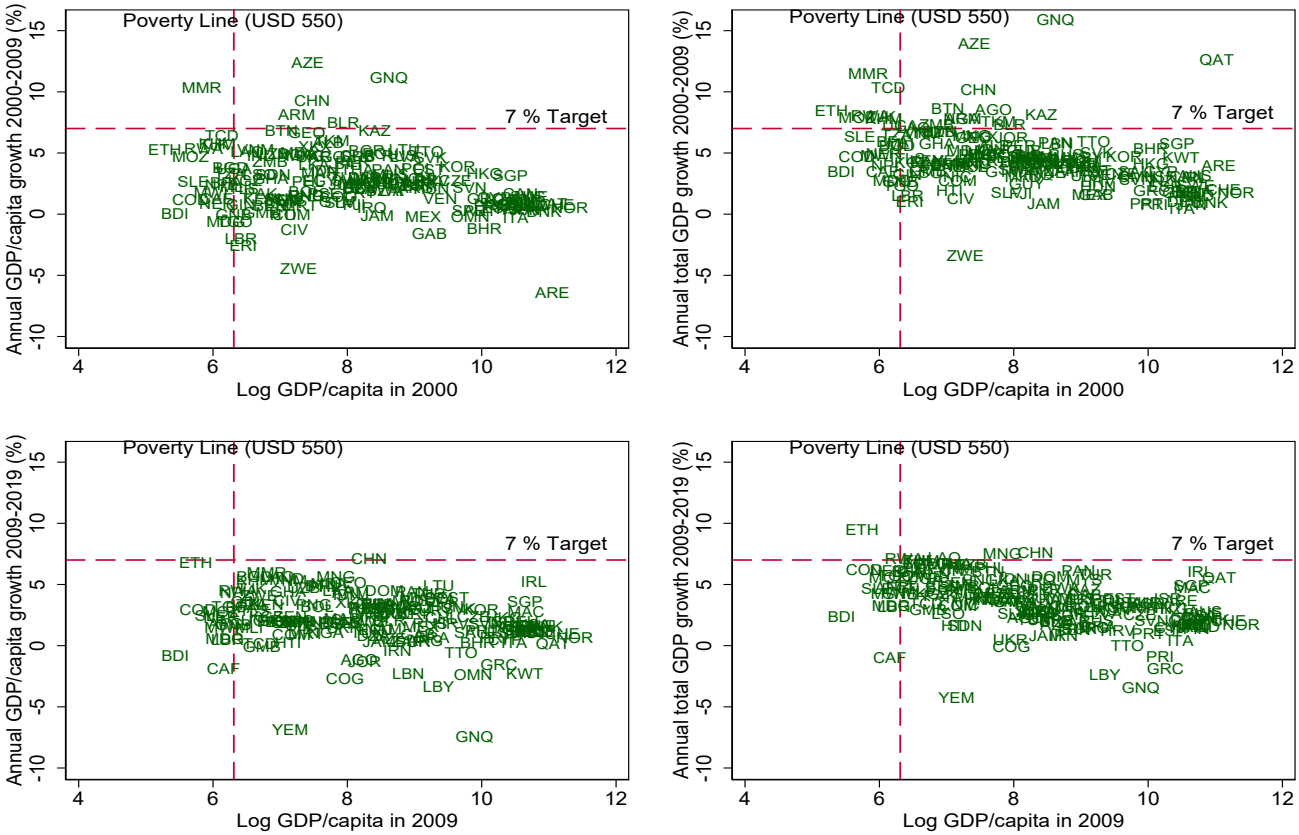
Figure 4: Annual growth in GDP/capita and total GDP by income quartiles since the 1960s



Notes: The lines represent the geometric averages of the annual growth rates in each income quartile. For each year, GDP per capita during the previous year is used to place countries in quartile 1-4, meaning that the composition of the quartiles changes over time. The upper figure shows the average annual growth rate of GDP per capita while the lower figure shows the average annual growth rate of total GDP. Data from the World Bank (2021).

In Figure 5 below we focus on the post-2000 decades. The upper two graphs show initial income in 2000 and average annual growth between 2000 and 2010. The lower ones show initial income in 2009 and average annual growth between 2009 and 2019. The left ones show growth in GDP per capita, and the right ones show total GDP growth. We have drawn two supporting lines in each of the graphs. The vertical line represents the USD 550 poverty line. The horizontal line represents the target of seven percent growth stated in SDG 8.1. While this target is for total GDP growth we have included it also in the graphs for GDP per capita growth for completeness.

Figure 5: Scatter plot of annual growth in GDP per capita and in total GDP and initial GDP per capita, 2000-2019



Notes: The upper figures show the unconditional relationship between initial log GDP per capita in 2000 and the subsequent annual growth rate of GDP per capita 2000-2009 in the figure to the upper left and the growth of total GDP in the upper right. The lower figures show the unconditional relationship between initial log GDP per capita in 2009 and the subsequent annual growth rate of GDP per capita 2009-2019 in the figure to the lower left and the growth of total GDP in the lower right. Each observation is represented by a three-letter country (iso-)code. Data from World Bank (2021).

In 2000-09, only a handful countries that were below the poverty line in the year 2000 also had a total GDP growth higher than seven percent (see the north-west quadrant of the upper-right graph). The countries were Cambodia, Chad, Ethiopia, Mozambique, Myanmar, Rwanda, and Tajikistan. In the extended 2010s (starting in 2009), only one country below the poverty line, Ethiopia, had a total GDP growth higher than seven percent. Evidently, the seven percent target is an ambitious one. Very few countries below the poverty line experience average growth higher than seven percent. By implication, having a low income and thus theoretically having more potential for catch-up growth is not enough to meet the SDG 8.1 target. This is also likely to reflect the fact that countries that remain poor today, are so because they never have had longer periods of high economic growth. To the extent that low growth rates historically were due to growth fundamentals, one has reason to be concerned about their future growth potential until such growth fundamentals improve or become less important in the growth

process. As we discuss in the next section, a more nuanced picture can be painted if one leaves the specific SDG 8.1 target aside and instead focuses on whether poorer countries grow faster than richer ones.

3.3 Convergence regressions

If the ambitious target of seven percent growth among low-income countries was met, it would mean that these countries would start to catch up with richer countries in terms of GDP per capita quite fast, from a historical perspective. Yet, such convergence would be the case even if the seven percent target was not met, as long as the growth rate was higher among countries with initially lower income than among countries with initially higher income.

In Table 1 below, we present the results of minimalistic regressions that can only uncover whether there is unconditional (absolute) convergence or not. The dependent variable is average annual growth in GDP per capita in the coming ten years. Initial Income is the log of GDP per capita at the start of the decade (or in the case of Column 6, in 2009).

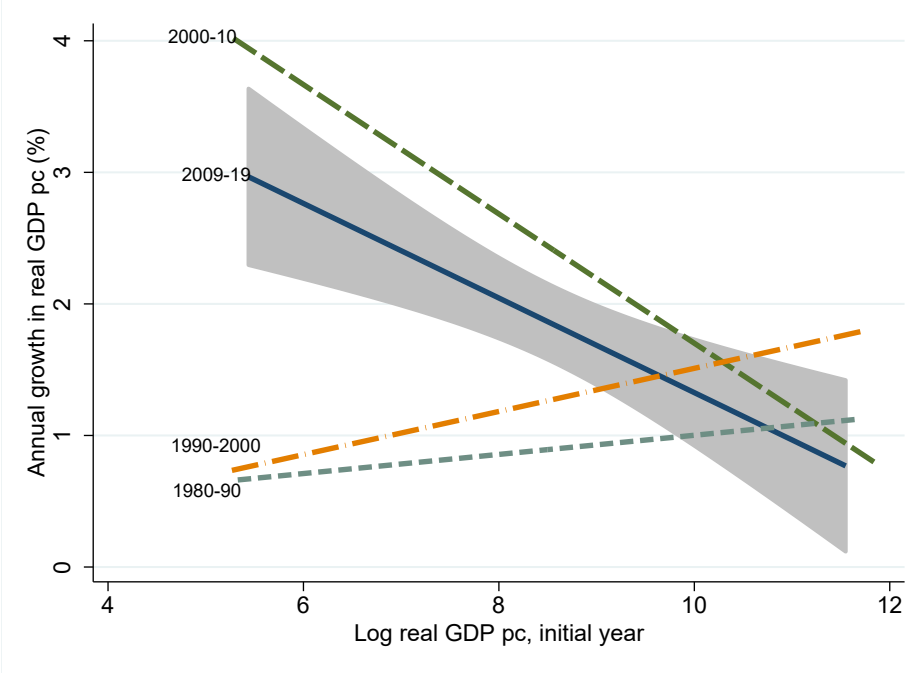
As has been shown by others (Barro, 1991; Pritchett, 1997), divergence rather than convergence was the case up until a few decades ago. The positive, though not always significant, estimates for *Initial Income* for all decades from the 1960s to the 1990s is an illustration of this pattern. Yet, as has also been shown lately by Kremer et al (2022), since the 2000s we have seen absolute convergence. The negative estimate for *Initial Income* in the columns for the 2000s and extended 2010s (starting in 2009) shows that countries that were richer to begin with had a lower growth rate in the following ten years.

Table 1: Absolute convergence regressions, 1960-2019

	DV: Average growth rate of GDP per capita					
	(1)	(2)	(3)	(4)	(5)	(6)
	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2009-2019
Initial income	0.590***	0.202	0.065	0.162	-0.489***	-0.362***
	(0.116)	(0.126)	(0.154)	(0.167)	(0.108)	(0.096)
Constant	-1.722*	0.683	0.328	-0.111	6.598***	4.941***
	(0.937)	(1.109)	(1.289)	(1.548)	(0.975)	(0.856)
Countries	93	118	142	174	196	188
R-squared	0.16	0.01	0.00	0.01	0.09	0.07

Notes: The dependent variable is Average annual growth of real GDP per capita (constant 2010 USD) during the decadal periods indicated. Initial income is Log GDP per capita in initial year. Robust standard errors in parentheses. Authors' calculations. Data from the World Bank (2021).

Figure 6: From divergence to convergence, 1980-2019



Notes: The figure shows the fitted OLS regression lines from equations (3)-(6) in Table 1 with a 95-percent confidence interval in grey around the last period 2009-19.

Figure 6 above illustrates the pattern shown in the regression table for the four later decades. The lines, with a 95-percent confidence interval for the 2009-2019 period, show how in the 1980s richer countries had higher growth rates, while in the period 2009-2019, poorer countries had higher growth rates.[8] This is consistent with absolute (unconditional) convergence.

3.4 Sustaining growth

The growth theory discussion in Section 2.1 may seem to suggest that theory predicts that economic growth should be a smooth process in which a continuous increase in capital, together with a stable rate of technological progress, results in a likewise continuous increase in productivity per worker and, where the employment rate is constant over time, GDP per capita. In reality, periods of higher economic growth are regularly followed by periods of lower growth. Part of this fluctuation in growth rates can be attributed to business cycle effects, but not all, and especially not among the less developed countries.

While the growth rates of many developed countries follow a reasonably stable path, that is not generally the case for developing countries (Pritchett, 2000). Many developing countries have much more

[8] Note that the linearity of both the results in Table 1 and the illustration of these results in Figure 6 is entirely imposed by the econometric specifications that we use here. Whether the true relationship between initial income and subsequent growth is linear or not is an empirical question that we do not address.

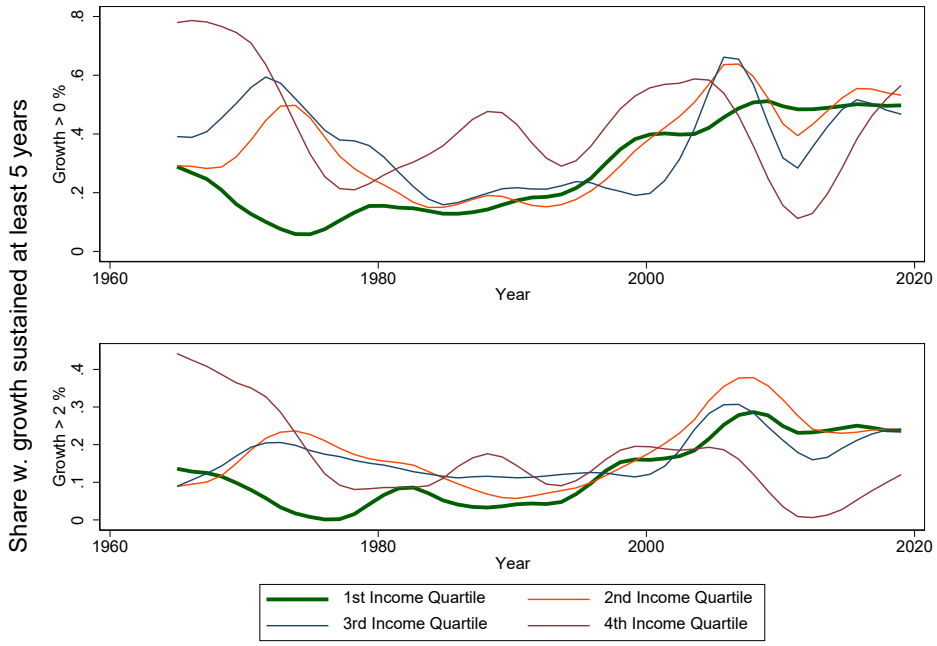
volatility in their growth rates, with shorter periods of high growth (which are frequently found in the data) being followed by sudden stops, slumps, and periods of stagnation. Consider a poor country with a low rate of economic growth. Internal factors, such as market reforms, or positive external shocks could set a process of higher growth in motion, a *growth acceleration*. The period of higher growth that ensues is often referred to as a *growth spell*. Again, either due internal factors or external shocks, this growth spell often eventually comes to an end, a growth break-down. To achieve high growth rate over a long period of time, this poor country must therefore not only experience a growth acceleration, but also be able to avoid a growth break-down.

The determinants of growth accelerations and duration of growth spells are not always the same (Arizala et al. 2017). For instance, while growth accelerations can be associated with improved exogenous conditions, the duration of growth spells seems to rely more on domestic conditions. Moreover, longer spells are due to the net of the effects on growth accelerations and growth break-downs, and the ability to achieve and avoid these, respectively, varies both over time and between countries. For instance, Arizala et al. (2017) find an increase in growth spells in Sub-Saharan Africa since 2000 and that this is more due to less frequent growth breakdowns than to more frequent growth accelerations.

Considering factors associated with the duration of growth spells, Berg et al. (2012) find that these are negatively associated with inequality, and positively associated with institutional quality, outward orientation, and macroeconomic stability. In light of this, it is not surprising that they find that growth spells historically have been shorter in Africa and Latin America. That inequality has a negative association with duration of growth spells does not necessarily imply that redistribution would lead to prolonged growth spells. Berg et al. (2018) discuss this complex relationship and finds that unless the redistribution is "extensive" it does have a positive effect on growth duration. Similarly, Kourtellos and Tsangarides (2022) find that inequality is (negatively) correlated with the duration of growth spells while redistribution is not.

There are also studies focusing on the duration of economic declines, rather than on the length of the growth spells or the determinants of accelerations or breakdowns. For instance, Bluhm and Thomson (2020) and Bluhm et al. (2020) show that economic declines tend to last longer in more ethnically fragmented countries and in countries with weaker political institutions. The favored explanation is that the duration of declines is related to governments having problems credibly committing to necessary reforms.

Figure 7: Sustained growth among four income quartiles, 1960-2020



Notes: For each year, the lines in the figures above represent the share of countries in each income quartile that has had a GDP per capita growth rate of at least 0 or 2 percent, respectively, for a period of at least five years. For each year, GDP per capita during the previous year is used to place countries in quartile 1-4, meaning that the composition of the quartiles changes over time. Data from the World Bank (2021).

The figure above, Figure 7, shows the share in each income quartile, which are created as discussed in Section 3.3, that has had a *per capita* GDP growth rate of at least zero or two percent, respectively, for at least five consecutive years. Countries in the bottom income quartile have gone from rarely being able to sustain even a positive growth figure for five years to being as good at doing so as countries in the top three income quartiles. Almost half of the countries in each income quartile are currently able to keep growth positive for at least five years. In the lower part of the figure, the benchmark is the, in the context of SDG 8.1, not overly ambitious growth rate of above two percent for a period of at least five years. Less than a quarter of the countries in any quartile are currently able to maintain such a growth rate. Yet, it is worth noting that the countries in the bottom quartile does not perform worse on this metric, as they did until the 1990s, but the opposite. For the first time in our sample period, the poorest countries are as good, and in some cases better, at achieving sustained positive growth.

Figure 8: Duration of growth spells

Notes: For each year, the lines in the figures above represent the geometric average of the number of years of the current growth spell for the countries in each income quartile. The duration of the growth spell for each country is the number of consecutive years with a per capita growth rate at or above the chosen cut-off. The upper figure uses a cut-off of 0 percent per capita growth per year and the lower figure uses a cut-off of 2 percent per capita growth. For each year, GDP per capita during the previous year is used to place countries in quartile 1-4, meaning that the composition of the quartiles changes over time. Data from the World Bank (2021).

Figure 8 shows mean duration of growth spells in each income quartile over time. All figures are here calculated using only countries that have been in the sample for at least six years. In the upper part of the figure, all years with a positive growth rate are considered. In the lower part, only years with a per capita growth rate of at least 2 percent are considered. Two key observations can be made. First, spell duration has increased in the poorest quartile for quite a long period of time. Second, while spell duration was longer in the top three quartile than in the bottom quartile in the 1960s, spell duration is now both similar (and longer) in the bottom three quartiles and higher than in the top quartile.

It should be noted that the benchmarks in Figures 7 and 8, which are 0 or 2 percent per capita growth rates of GDP, are much more modest than the figures stated in the SDG 8.1. Still, the data shows that the poor countries are moving in the right direction, and that their capacity to sustain positive growth over longer periods of time seems to have improved

3.5 Sustainable growth?

Even if growth appears to have been sustained over longer periods of time in the low-income countries, a crucial issue is whether economic growth is *sustainable* in the sense that it does not threaten other

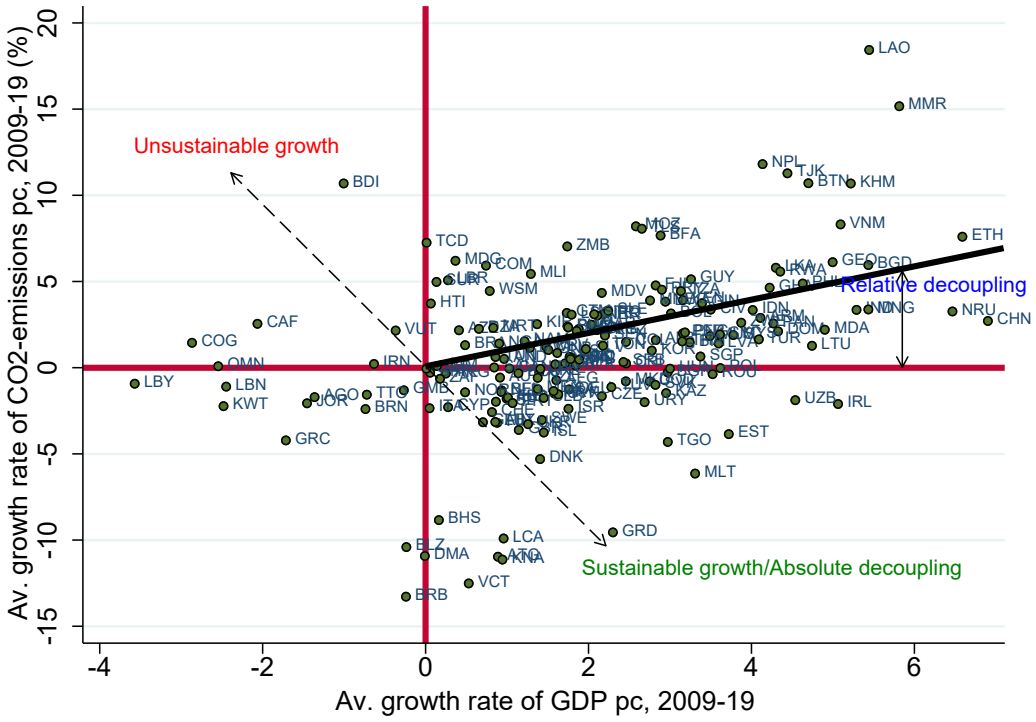
important SDG goals. For instance, SDG 8.4 addresses the question whether economic growth can be *decoupled* from environmental degradation in the form of excessive material footprints from domestic consumption and production.[9] In this section, we will briefly consider the issue of whether economic growth must inevitably lead to more emissions of CO_2, or whether growth can be decoupled from increasing emissions and perhaps even be associated with lower emissions.

In the literature, three basic levels of decoupling are discussed: *Absolute decoupling*, implying that countries have positive economic growth *and* decreasing CO_2-emissions; *relative decoupling*, implying that economic growth is faster than the growth rate of CO_2-emissions, and *no decoupling* in all other cases. Some social scientists argue that continuing economic growth is probably not at all compatible with a carbon budget that keeps the global increase in temperature below 2°C and that decoupling analyses therefore are not meaningful (Ward et al, 2016; Hickel, 2019). The most thorough recent study of decoupling that we could find, focusing on CO_2-emissions, is Hubacek et al. (2021). They find that during 2015-2018, 32 out of 113 countries (28 %) achieved absolute decoupling, but also that these countries still add carbon to the atmosphere.

In our analysis, we analyzed the correlation between average annual levels of economic growth in GDP per capita 2009-19 and average per capita emissions of CO_2 from production for the same period, using data from the World Bank (2021). Figure 9 shows a scatter plot of the two variables. We have divided the graph into three basic areas: A quadrant characterized by absolute decoupling in the lower right, a triangle with observations characterized by relative decoupling to the middle right, and all the rest of the graph with countries that are neither characterized by absolute nor relative decoupling. Progress in terms of sustainable economic growth implies a substantial presence of countries in the lower right quadrant whereas negative economic growth combined with increasing carbon emissions in the upper left corner is unsustainable.

[9] Decoupling is usually measured as $D = (\Delta_z y_{it} - \Delta_z CO2pc_{it})/\Delta_z y_{it}$ where $\Delta_z CO2_{it}$ is the average growth rate in CO2-emissions per capita measured over z years either as production or consumption (Hubacek et al, 2021). A conceptual problem with this measure is that in cases when $\Delta_z y_{it}$ is close to zero, the measure will go to infinity. For that reason, we do not use it here.

Figure 9: Scatter plot of average growth rates of CO_2-emissions and of real GDP per capita, 2009-2019



Note: The figure shows a scatter plot between the average annual growth of CO_2-emissions per capita 2009-2019 on the vertical axis and average annual growth of real GDP per capita 2009-2019 on the horizontal axis for 177 countries. Two outlier countries with extremely low growth rates of GDP per capita are excluded from the graph.

Starting with absolute decoupling, no less than 58 countries are found in the lower right quadrant, very close to 1/3 of all countries in our sample. Along a discernable *decoupling frontier* in the lower part of the quadrant are countries like Ireland (IRL) with a GDP per capita growth of 5.1 percent and a decrease in carbon emissions of 2.1 percent, Malta, Granada, and Saint Vincent and the Grenadines. The category includes major countries such as the United States and many EU countries, but also several countries in the West Indies. These countries generally have higher than average absolute levels of CO_2-emissions and levels of GDP per capita.

46 countries are in the relative decoupling-triangle, including countries such as China and India. Most countries (58%) are thus characterized by either absolute or relative decoupling. Relatively few countries had negative growth during the period and lie to the left of the vertical line at 0 percent growth in GDP per capita. An outlier here is Burundi (BDI), currently the poorest country in the world and often characterized as a fragile state. Overall, 75 countries (42%) have no decoupling in a statistical sense. However, in this category are still countries like Barbados (BRB) where GDP per capita declined by 5.5 percent but where CO_2-emissions decreased with no less than on average 13 % each year.

In summary, it is clear that economic growth can be combined with reductions in CO_2-emissions. A closer analysis of what characterizes the decoupling frontier of countries, is a natural area for future research.

4. Discussion

In this section, we address three additional topics: (i) The development during (and implications of) the COVID-19 pandemic, (ii) whether research has a role to play for pro-growth policy and for the fulfillment of SDG 8.1, and (iii) areas of future research.

Our empirical analysis has been made on a period ending with the year 2019. In early 2020, the world was struck by the COVID-19 pandemic. From 2020 to September 2022, it is estimated that some 6.5 million died from COVID-19 worldwide and that at least 600 million were infected (Worldometer, 2022). In general, COVID-19 casualties are mainly found among old, non-working age people. Low-income countries appear to have suffered fewer COVID-19 deaths than high income-countries.

The pandemic caused one of the most severe worldwide economic shocks since the World Bank started recording GDP data. Data on the effects on GDP levels are now available for both 2020 and 2021. For the world as a whole, the growth rate of GDP was -3.3 % in 2020 but bounced back to 5.8 % in 2021. The 2020 decline was not as serious in the *Low Income*-countries where growth was 0.1 % in 2020 and 3.0 % in 2021. For *Sub-Saharan Africa*, the equivalent percentages were -2.0 % and 4.1 %. Poorer countries were in general not as badly hit by the pandemic as *High Income*-countries (-4.5% in 2020) but also did not have as strong recovery in 2021 (5.1%) (World Bank, 2022). Total worldwide emissions of CO_2 also fell by -5.2 % in 2020 to 35 billion tons (Gt). This level was still equivalent to a 480% increase since 1950 (Richie et al., 2020). The data for 2021 showed again a rise in emissions to 37.9 Gt.

Just as COVID-19 released its stranglehold on economies in the early months of 2022, a new geopolitical shock occurred: The Russian invasion of neighboring Ukraine. The war immediately had a strong impact on world energy and food prices, which hit many poor countries particularly hard. At the time of writing (April 2023), it appears likely that the growth resurgence of 2021 will taper off from autumn 2022, especially in Europe. In general, there are many reasons to believe that the post-covid world economy will be quite different from before 2020 and that the Russia-Ukraine War will loom over developments during several of the years leading up to 2030. Expectations of future economic growth are a lot more uncertain and many observers think that several SDGs, including those of SDG 8.1, will be even more difficult to reach (Naidoo and Fisher, 2020). It seems likely that the world economy will undergo a structural transformation towards an even faster transition to renewable energy, a severance of economic relationships between Russia and the West, an increasingly strained relationship between United States and China, and a reorientation of supply chains and of globalization in general that could potentially

have a great impact on the prospect of a future industrialization in poor countries. The implications for economic growth in low-income countries are probably important but it is extremely difficult to predict the consequences in any detail.

Does research have a role to play for the development of policies promoting SDG 8.1, i.e., a high economic growth for the poorest countries? We believe that new cross-country research is *not* likely to have a major direct impact on pro-growth policies. Yes, there is a wide literature in economics on economic growth and it demonstrates the importance of rule-of-law, the absence of corruption and conflict, the hazards of natural resource rents, the long-run benefits of investments in infrastructure and education, etc. The main constraint to good institutions and policies is, however, not that policymakers are unaware of these findings. Some well-known development economists argue that these findings are not very *useful* since they do not provide clear-cut policy lessons (Banerjee and Duflo, 2020). Our view, which lies closer to that of Acemoglu et al. (2005, 2006), is that the main constraints are *de facto political institutions*. Regardless of how clear the lessons from research are, pro-growth policies will still not be adopted if a small elite with unproportionally large power stand more to benefit from corruption, a weak rule-of-law, and low-quality government investments that mainly function as a cover for enriching elite individuals. Nonetheless, country-specific research on constraints to economic growth might have an indirect effect on individual country policies when the fundamental institutions for inclusive growth are in place. The "growth diagnostics"-framework of Hausmann et al. (2005) might be useful for careful policy analysis for individual countries in this regard.

Furthermore, we believe that a promising area for future research would be to scrutinize the experience and policies of countries that have managed to decouple economic growth from CO_2-emissions. This is the path that all countries in the world must embark on very soon in order for climate goals and sustainable economic growth to be achieved.

5. Conclusions

In this report, we have discussed the conceptual framework for the targets regarding economic growth in SDG 8.1, as well as empirical evidence of target fulfillment. We conclude that much of the published research on SDG 8.1 has been produced by non-economists without a background in growth theory or growth empirics. This is possibly one of the reasons why the literature so far, in our view, is plagued by conceptual misunderstandings and mischaracterizations. On a fundamental level, it appears that some observers argue that it is possible to increase investments in public goods like health and education in poor countries even if these countries do not experience economic growth. With a number of examples, we have tried to illustrate that the enormous current gaps in GDP per capita and in the quality of life between the poorest and richest countries, are not likely to be closed unless underdeveloped countries experience relatively high growth rates in GDP in the decades to come. It is also the case that the targets

concerning economic growth in SDG 8.1 naturally complement the achievement of other SDG goals, such as the reduction of poverty (SDG 1) and hunger (SDG 2). In writing the report, we have become convinced that it is important that economists contribute to a greater extent to this debate in the social sciences since macroeconomic growth is primarily a research field within economics.

When reviewing the empirical record on economic growth, we show that growth rates above 7 percent have only been observed for individual country-years in about 10 percent of all years with GDP data. Sustained periods of 7 percent economic growth are very rare historically and during the last few decades. A strong convergence of income levels has nonetheless been observed during the last two decades before the COVID-19 pandemic. Furthermore, almost a third of all countries have experienced an absolute decoupling of economic growth from carbon emission growth during 2009-19. This is promising but not sufficient for a truly sustainable path for economic growth in the years ahead. The big challenge will be to establish trajectories that make possible a relatively high growth rate among the poorest countries while at the same time ensuring that CO_2-emissions fall drastically on a global level. A key future research question is how an up-scaling of successful country examples of decoupling and sustainable economic growth can be accomplished for the world as a whole.

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